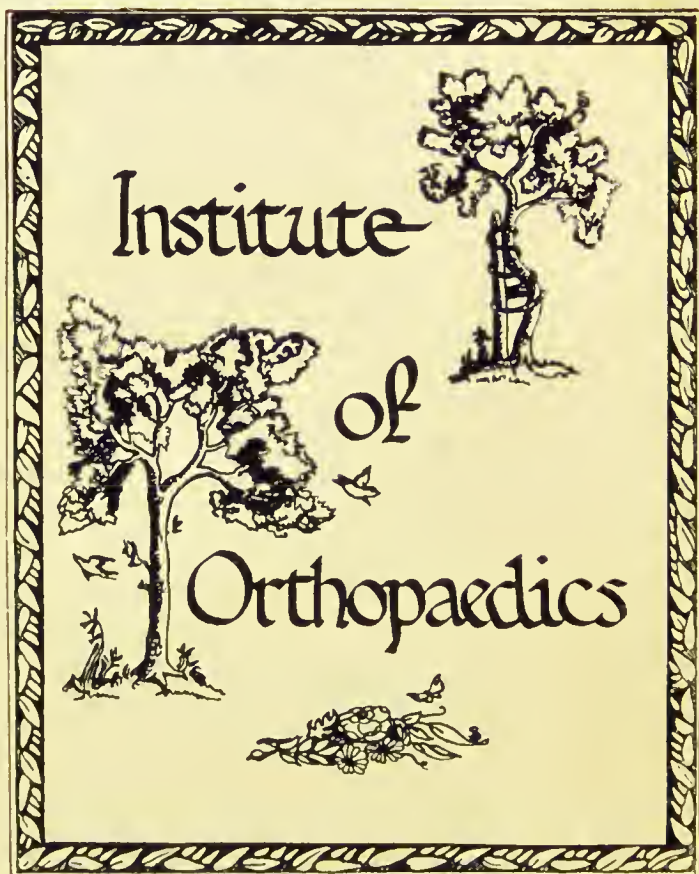


**DISEASES**  
**OF THE**  
**HIP, KNEE, & ANKLE JOINTS**  
**BY**  
**HUGH OWEN THOMAS.**





SC WE THO

Arch.

~~Thacker~~ Jones Bell



DISEASES  
OF THE  
HIP, KNEE, AND ANKLE JOINTS  
AND THEIR TREATMENT.  
BY A NEW AND EFFICIENT METHOD.



*will Mr. regard*

DISEASES

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BY A NEW AND EFFICIENT METHOD.

BY

HUGH OWEN THOMAS.



LIVERPOOL:

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2063

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TO

MY FRIEND AND RESPECTED FELLOW  
TOWNSMAN

DR. F. AYRTON,

AS

AN ACKNOWLEDGMENT,


THOUGH AN INADEQUATE ONE,

OF

MANY VALUABLE SERVICES RENDERED

TO THE

AUTHOR



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ERRATUM.

Page 45, line 20, for *formations* read *fomentations*.

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## PREFACE.

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IT is proposed in this treatise to introduce to the notice of the Profession the Theory, and an Efficient Method of, Treating DISEASES OF THE HIP, KNEE, and ANKLE Joints. This method, after many years of experience and exceptionally frequent opportunities of trial in practice, in over one thousand cases, I feel confident, judging from its results, is a vast improvement on all the modes of treatment hitherto practised in this department of Surgery.

The means usually employed by Surgeons, in treating Diseases of the Hip, Knee, and Ankle Joints, have rarely been followed by resolution.

It is no exaggeration to assert that a majority of those cases that are benefited are but defectively cured.

The reader will be introduced to surgical appliances and details, &c., which involve radical changes of treatment, and are now for the first time made known to the Medical Profession.

I feel assured that this method will reclaim this class of diseases from the domain of excision, and make amputation more rare. I shall not enter into the pathology of the various stages of these diseases, as they have been already so minutely described by abler writers. Nothing, in fact, has been left unsaid as regards their pathology ; indeed, we might almost suppose that some of the writers had themselves been sufferers, so graphic and correct have been their descriptions.

By following this new treatment, the practitioner will be agreeably surprised at the absence of many of the usually recorded symptoms. Even

in those cases where the disease has run a course of some severity, their recovery may be attained with but little perceptible defect.

I fear that these pages, written as they have been during hours which should have been devoted to rest, will be found faulty in many respects; but an anxiety that the Profession should test these methods has induced me to submit this treatise to them without further delay.

My acknowledgments are due to my talented friend, Mr. Rushton Parker, for his criticism and supervision, nor can I omit this opportunity of thanking the Artist, Mr. Lewis, for his care and fidelity in copying the Photographs, so well taken by the Liver Photograph Company, who very much facilitated my labour by kindly placing their establishment and staff at my sole disposal for an entire day.

MESSRS. KROHNE & SESEMANN, 8, Duke St., Manchester Square, W., London, the eminent

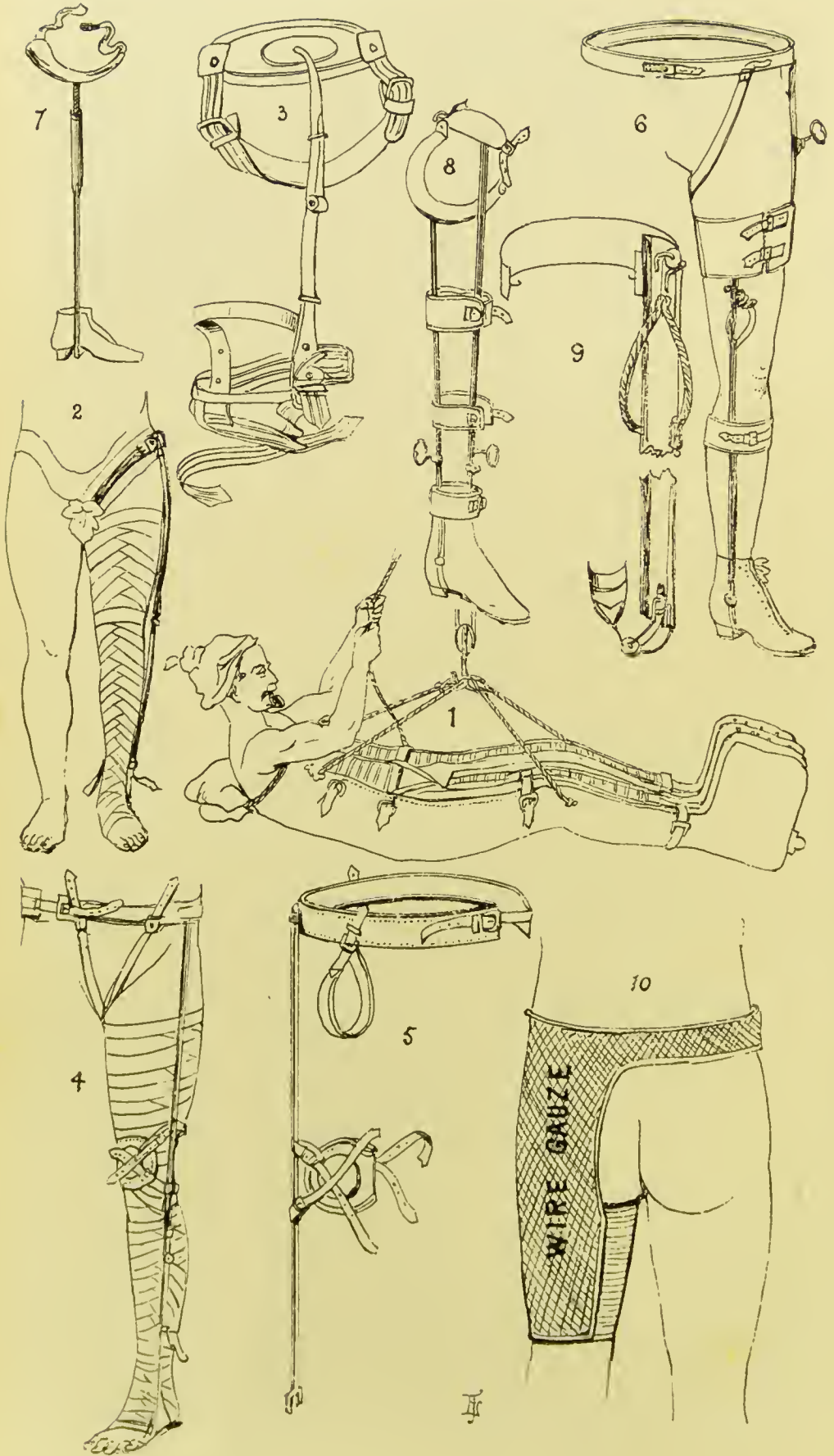
instrument makers, have made themselves acquainted with my practice, &c., and can supply any of my appliances.

11, NELSON STREET, GREAT GEORGE SQUARE,  
LIVERPOOL, *July*, 1875.





# PLATE 1



## CHAPTER I.

---

### HIP JOINT APPARATUS.

---

**D**URING the last twenty years, various designs in wood, iron, wire gauze, leather, gutta percha, gypsum, silicate of potash, solutions of shellac, plaster of Paris, and combinations of these, have been used in the treatment of hip joint disease. I have used very many of these in practice during my early career, and have well considered every known model and design in use in Europe and America, and I trust it will not be deemed presumptuous if I point out what I consider to be the merits and demerits of these various appliances; many of them having been constructed

at the suggestion of gentlemen well qualified to do so.

In France, Bonnet seems to have been the designer of the favourite appliance ; but in vol. ii. of his work on diseases of the articulations, page 327, he does not report well of it ; and on referring to the *Atlas* accompanying his work, I notice that the pelvic portion of this machine is defective in restraining the movements of the hip joint. Yet the design is a most excellent one, and Charriere's modification of Bonnet's "Grand Appareil," which embraces the trunk as well as the pelvis, is a very important improvement. The machine is a very efficacious one, but very cumbersome ; and owing to its high price (250 francs), is only attainable by wealthy patients and the larger charities.—This appliance is shown in *plate* 1, *fig.* 1. We may describe this instrument as one of "posterior fixation."

Our professional brethren in the United States, have been most prolific in the invention of means



for treating this disease. To *Dr. H. G. Davis*, of New York, is accorded priority in the invention of the "Perineal and Side Splint with Counter Extension," for disease of the hip joint. It is arranged with the intention that the patient should not remain at rest, but that he may continue to perform all the movements of the joint. The designer of this instrument assumes that by its means the weight of the trunk is removed from the joint, the surfaces of which are relieved from pressure.—This instrument is depicted in *plate 1, fig. 2*.

Following in the wake of Dr. Davis, we find Dr. Louis Sayre, of New York, whose appliance is the same in principle as the last named, but designed as an improvement upon it, the modification consisting simply in this:—that Dr. Davis' Splint is composed of wood, webbing, bandages, and plaister, while Sayre's substitutes steel for Davis' wood.—This instrument is shown in *pl. 1, fig. 3*.

Taylor's, again, is a modification of Sayre's appliance, the modification consisting only in the extension of the steel bar down to the ankle, instead of merely to the calf.—*See plate 1, fig. 4.*

We have also Washburn's Splint, designed for the poorer classes of patients. This appliance is devoid of the complications which mar so much the usefulness of the instruments employed in this department of surgery, such as screws, racks, and pinions. This instrument consists of a pelvic band, outside steel bar, and knee-cap; the end of the steel bar being attached by adhesive straps to the ankle; and is, in principle, identical with that of Davis'.—*See plate 1, fig. 5.*

Another variation met with is the appliance of Dr. J. C. Hutchinson, of Brooklyn, U.S. This is a design similar to Taylor's, but it possesses an inside as well as an outside steel bar, the bars being attached by means of an iron joint to the sole of the shoe.—*Plate 1, fig. 6.*

The last five appliances are variations of one type, and may be called "perineal extension instruments," involving within their construction the principle and details of Messrs. Davis' and Sayre's; and all possessing alike the demerits of the original design. Their inventors profess to cure hip joint disease by relieving pressure, while yet permitting movements of the joint.

I hold that, for mechanical reasons, this relief of pressure must be infinitesimal, if any at all, and I know, from practical experience, that a cure, free from defect, is impossible with the use of these appliances. I admit that when applied, some relief from pain may, and often does, occur, but not as a result of the application of the instrument; and I do not regard such relief as a benefit to the patient under the circumstances, because I have found that though temporary ease is produced an effectual cure is never attained.

I know that often when rupture of the joint takes place, some relief follows, and I am disposed

to offer this, as an explanation of those instances, in which marked relief follows the application of this irrational method. I confidently believe that the non-resolution of the inflammation is due to the friction of the inflamed joint surfaces which these machines increase rather than arrest.

In the year 1863, Dr. Davis published his account of his instrument. I became acquainted with this in the same year, but on rational grounds I was opposed to it, and did not venture to use it.

Since the visit of Dr. Sayre to England and the exposition of his method to the London surgeons, I have seen several instances in which his apparatus was skilfully applied, and from personal knowledge I am satisfied that in not one of these cases was the disease benefited or even arrested.

The best commentary upon this method is the remarkable frequency with which its principal advocate has had to perform excision. Persistent



use of his instrument tends to the conditions necessitating this operation.

The next class of instruments are those designed upon the principle of ischiatic support. To *Dr. Andrews*, of Chicago, is ascribed the merit of having designed this very ingenious contrivance. It consists of the ordinary crutch-head, attached to a steel stem passing down the inner side of the thigh, and fixed to the heel of the boot. This is supposed to support the body by counter-pressure against the tuberosity of the ischium and groin. This may take a fraction of the weight of the body off the hip, but makes no provision for controlling the joint movements, and consequently it is of no practical value in cases of hip joint disease. After testing it in practice, I have found that the results are not satisfactory. This appliance is depicted in *plate 1, fig. 7*.

*Dr. Bauer*, of New York, has also adopted a modification of this design, which consists of the inside stem and crutch-head, with the addition of

an external stem, both stems being attached to the shoe.—*Plate 1, fig. 8.*

Another method, which has occasionally been made use of in this country is that practised at the *Varral* Institution, and consists of anterior reclusion of the whole body upon a double inclined plane : much the same position as that used for treatment of spinal curvature in that establishment.

Another instrument, partaking of the perineal type, is that designed by our respected fellow-countryman, Mr. Barwell, of London. At one time I made a persevering use of it, and the results, in the cases of adults, were sometimes successful, but with children, rarely so; and my experience of it has fully convinced me, that fixing the thigh to the pelvis alone, by any method without the aid of the leverage of the trunk, is very deficient in controlling the joint, and inefficacious as regards results. Mr. Barwell's instrument consists of an outside wooden splint,

perineal band, pulleys, and pelvic band, with an arrangement for elastic extension. When the patient is disturbed, the length of the outside splint, attached to the lower extremity, acts as a lever, to resist the force of which leverage, the pelvic band is not sufficient. Owing to this defect, Bonnet's original design was not satisfactory to himself.

Charriere having increased the leverage in the upper portion of his apparatus, the leverage of the lower portion is balanced, and so he has made a very excellent instrument. But it is possible, with great care and attention, to produce a fair recovery in some cases, with Mr. Barwell's apparatus, and I admit, that with the exception of the old-fashioned long splint, it has been, for years, the best instrument at the surgeon's disposal. Mr. Barwell's appliance possesses an advantage over all the American designs, in that it has some little control over the movements of the joint. Painless nursing of the

patient is impossible with his appliance, a fault possessed alike by all the others to which I have referred.—*Plate 1, fig. 9.*

*Professor Hamilton's* apparatus for hip joint disease, as described in *Tinemann & Co.'s Catalogue*, seems constructed to control the movements of the joint, but is not of much value, and I can best convince the reader of this by referring him to *plate 1, fig. 10*, which is taken from the above catalogue; in this instrument the upper and lower lever are too short.

Finally, we come to the old-fashioned long splint, which, when applied from the axilla down to the ankle, is an instrument possessing merits beyond any of those I have previously discussed; yet, it has its faults, as, being applied laterally, it can only partially control the joint movements, and the nursing of the patient is not without pain.

The design that I shall submit to the profession is free from the defects of all the previous







appliances; is cheap, and within the reach of the poorest; is light, and can be applied under the clothes without much disfigurement to the patient's appearance, and enables the attendant to nurse and handle the patient about as though he were a toy, and without pain.—*See plate 2.*

I have not entered into the demerits of the shellac, silicate of potash, and other solutions, as they do not admit of being applied beyond the pelvis; consequently they have a serious practical defect in being short of trunk leverage to balance the limb portion.

I will conclude by reference to the method of treatment by weight and pulley, which amounts to no more than confinement to bed. Dr. H. G. Davis, the author of the perineal system of treatment of hip joint disease, is credited with having suggested the use in hip affections of this useless, and, worse than useless, deceptive method of treatment.

Our Transatlantic brethren deserve praise

for having studied diligently to improve the treatment of these joint affections, but by ignoring in their designs, the fact, that friction is a greater evil than pressure, have devised methods of less efficacy than those previously in use.

In confirmation of the correctness of my opinion as to the evil of friction in joint inflammation, I refer to the lower jaw articulation. In this joint we rarely have inflammation, but when that does occur, it is more liable to be followed by ankylosis, than in any other joint, in consequence of the impossibility of controlling its movements.

---

## CHAPTER II.

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### DISEASES OF THE HIP JOINT.

---

IT is of the utmost importance that any abnormal condition of the hip joint should be detected, at the commencement of the disease. We have hitherto had no method of determining with certainty the existence of the disease, at an earlier period than three months, except in very rare cases, where for example acute inflammation is very rapidly developed without any premonitory warnings, such as lameness, pain round the patella, disturbed sleep and wasting of the nates. We have also to guard against the possibility of mistaking abscesses connected with the

spine, or arising within the pelvis, sciatica, or hysterical simulation of this complaint, for Morbus Coxæ.

The diagnostic method which I shall demonstrate is of value to the surgeon in the cases of children in particular, as he can get all information in defiance of the struggles of the patient, and without administering an anæsthetic, and it enables him to know how long a time the patient may have been suffering, whether two weeks or twelve months. For all practical purposes the symptoms are often as well defined in twelve months, as they are in as many years.—*Plate 3* illustrates the manipulation in this diagnostic method.

Having undressed the patient and laid him on his back on a table or other hard plane surface, the surgeon takes the sound limb and flexes it, so that the knee joint is in contact with the chest. If the patient be thin and spare, let the limb be pressed and maintained on the





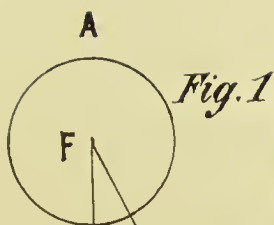
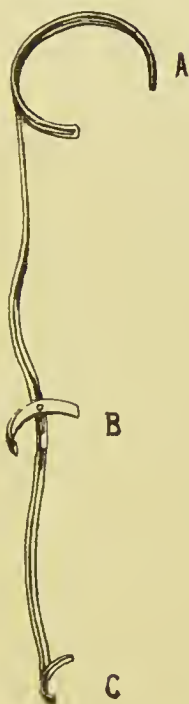


chest firmly, but if the patient be stout, let there be a little less pressure. Thus the surgeon makes certain that the pelvis is in normal line with the spine, and fixed thus, the sound limb becomes a lever wherewith to maintain this normal position. Now let the surgeon attempt to pass his hand between the lumbar spine and the table. If not able to do so, then the diseased limb must take his attention, while an assistant maintains the flexion of the sound limb on the chest, which controls the spine and pelvis. He then requests the patient to extend the diseased limb, at the same time assisting him very gently and slowly to its utmost range of extension. The amount of flexion shewn in the illustration *plate 3*, (an angle of 160 degrees with the pelvis) indicates, according to my observation, an inflammation of about six weeks' duration. The angle gradually decreases as the disease progresses, if uncontrolled; the amount of flexion indicating the duration up to twelve months, which at that period often reaches a right

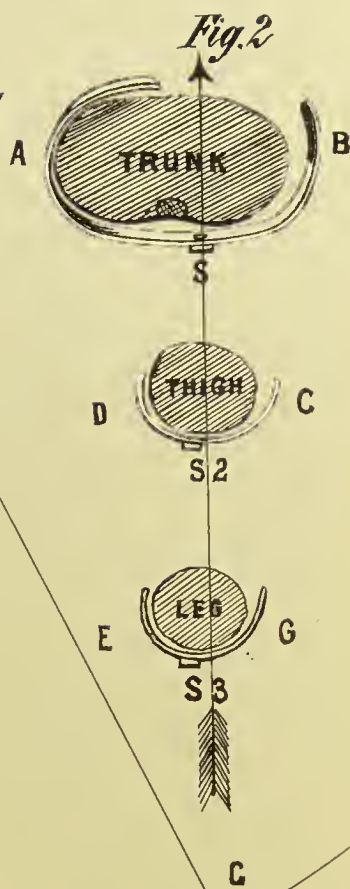
angle. If now the healthy extremity be released, the patient, if one who has suffered but a short period, may be able to extend the diseased limb perfectly straight, so as to conceal the flexion, but if the surgeon places his hand under the spine, he will detect the curve as depicted in *plate 5*, which curve is produced in the tilting of the pelvis, and obscures the slight contraction that is invariably present, even in the earliest stage, and so falsify an Examination by the old method. This flexion explains the peculiar limp these sufferers have at the commencement, a false shortening only. Thus if we suppose the pelvis to be represented by A, *plate 4, fig. 1*, the ground by BC, and that FE represents the lower extremity, then on any movement of the limb forwards, such as represented by FG, which being of the same length as FE, FG would be too short to reach the ground BC. To make FG reach the ground, the pelvis is tilted forward, and this can only be done by

# PLATE 4

*Fig. 4*



*Fig. 1*

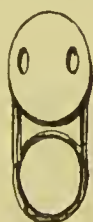


*Fig. 2*

*Fig. 3*



*Fig. 5*



*Fig. 6*



*Fig. 7*







PLATE 5





an extra curving of the lumbar spine, hence the necessity of fixing the spine and pelvis. This diagram exactly shews the cause of the apparent shortening in this disease, before absorption of the head of the bone, &c., has taken place. Then we may have a real shortening at an advanced period.

*Plate 5* represent the patient's spine as curved when the leverage of the sound limb is taken off the pelvis, and equal to a duration of many months.—*Plate 6* shews the same case with the leverage of the sound limb fixing pelvis, and so controlling the spine. In cases of abscess connected with the pelvis or spine, this curving of the latter is absent when the patient makes an attempt to extend the limb. Here we have contraction of the flexors without hip disease. In simulated or hysterical affections of the hip joint, the patient is able, when the pelvis is fixed, with the leverage of the sound limb to extend the simulated one. I have frequently successfully diagnosed cases in this manner that

were judged serious, the subsequent termination of the case confirming my diagnosis. The lengthening of the limb, which is sometimes noticed in this affection, arises from obliquity of the pelvis, which, if we allow for when we make the examination, the limb will appear with the usual shortening.

There is an opinion prevalent, that only gentlemen on the staff of our public charities can treat with any chance of success this affection, and certainly, hitherto, they have had advantages not possessed by the general practitioners, having at command the wealth of the charity, to which they are attached, and being thereby enabled to order the costly appliances at present in use.

Persons living at a distance from large towns, rarely receive professional assistance, as the one thing supposed to be needful cannot be obtained at home. This has induced me to describe such details, as will enable the surgeon to treat his cases at home, with no more mechanical assistance



PLATE 6





PLATE 7





than can be rendered by the village blacksmith and saddler, and the poorer class of sufferers will at a small cost be assisted as effectually as the wealthier classes.

We will suppose the patient, a boy of about 10 years of age, having been examined, and the affection diagnosed as disease of the right hip joint, the surgeon proceeds to measure him for the instrument. He requests the patient to stand on the left limb (the one supposed to be sound), and then places under the sole of the right foot a block or a book, one inch thick, telling him to rest the foot of the affected limb on it. If the spine is then straight he is ready to have the contour of the sound limb taken. If the spine is not of normal line, then add another block, or several blocks, until the unsound limb is raised sufficiently to allow the spine to resume its natural condition, as in *plate 7*. Now take a long flat piece of malleable iron, one inch by a quarter for an adult, and

three quarters of an inch by a quarter for children, and long enough to extend from the lower angle of the shoulder blade, in a perpendicular line downwards over the lumbar region, across the pelvis slightly external to the posterior superior spinous process of ilium, and the prominence of the buttock, along the course of the sciatic nerve to a point slightly internal to the centre of the extremity of the calf of the leg. The iron must be carefully modelled to this track, to avoid excoriations, which would otherwise trouble the patient during treatment. This iron forms the upright portion seen in *plate 4, fig. 4*. It is also very necessary that this upright should come below the knee, to enable the surgeon to fix this joint, otherwise the patient would flex the knee, and rising the leg as a lever, would strain the hip joint. Then measure round the chest, a little below the axilla, deducting, in the case of an adult, three inches from the chest circumference. This latter will

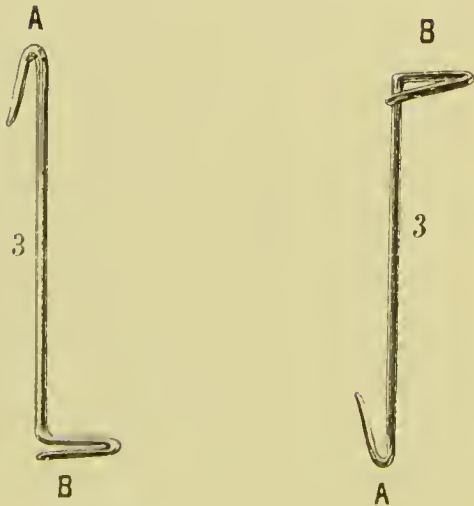
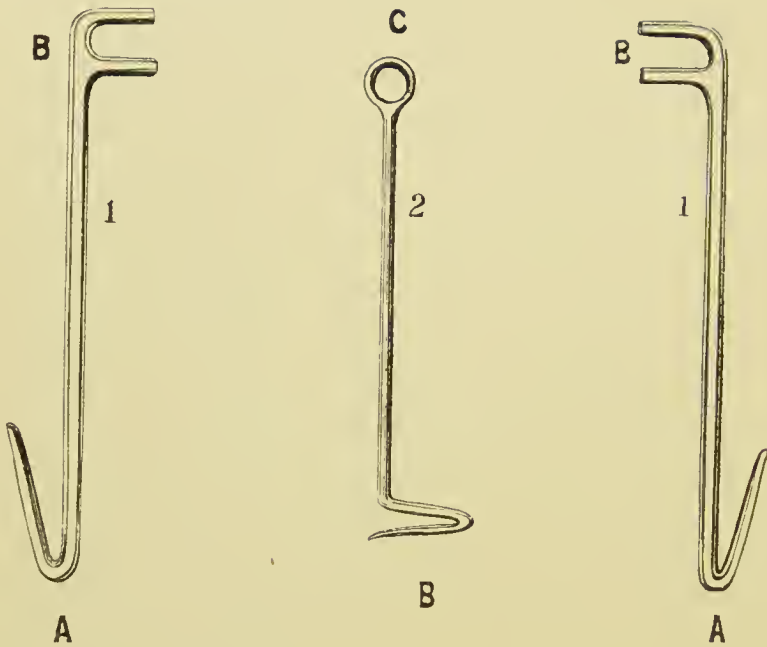
be the measure for the upper cross piece, which is made from a piece of hoop iron, one and a half inch by one eighth of an inch. The hoop iron is firmly jointed with a rivet to the top of the upright, as shewn in *plate 4, fig. 4*. At one third of its length from the end next to the diseased side, as *plate 4, fig. 2 s. Fig. 2* in *plate 4* shews the upper ring modelled to the outline of the trunk, which is oval in shape. It is important to give the upper crescent this oval shape, otherwise the machine will rotate from its position behind the body, also inversion of the limb will occur. Another strap of hoop metal five-sixteenths of an inch by one eighth of an inch, and in length half the circumference of the thigh, is fastened to the upright, at a position from one to two inches below the fold of the buttock, as in *fig. 4 B, plate 4*, according to the age of the patient, then another piece of metal of like strength equal to half the circumference of the leg at

the calf is firmly rivetted to the lower extremity of the upright, as in C *fig. 4, plate 4*. In the sectional diagram, *plate 4, fig. 2*, the forms of the cross pieces there given should be carefully noticed, especially the points of junction with the upright marked *S*, as being out of centre. The short portion of the top half circle is next to the diseased side, while the long portion must be closely fitted to the sound side. In my earlier experience the upper crescent embraced the pelvis instead of the chest, but I found it very inefficient, difficult of application, and painful to wear.

The instrument is now ready to be padded and covered by the saddler with basil leather. However correctly it may have been modelled, it will often occur, that some slight alteration will be demanded, when it comes to be applied to the patient, either on the first day, or at some period during the progress of the case, or the case may be one of long duration,



PLATE 8





uncontrolled, and consequently be attended with much deformity, then the surgeon may have weekly to alter the curves, &c., of the appliance. To enable him to do this, I have devised and used the instruments and wrenches shewn in *plate 8*.

For instance, it may happen that the upright portion of *fig. 4, plate 4*, may require a little rotation outwards, which can be done by the hooked ends A A of the instruments 1-1, or 3-3, *plate 8*, or the concavities may require to be increased or decreased, which can rapidly be done with the extremities B of the instruments Nos. 1, 2, and 3. The two lower short crescents can be altered with the C end of *fig. 2, plate 8*. By the aid of these the surgeon is always independent of any mechanical (cutler, &c.) aid until the case has terminated, or he may remodel an old appliance to use again. The patient being placed in the machine, a strap and buckle close the upper circle round the chest, and the limb is bound

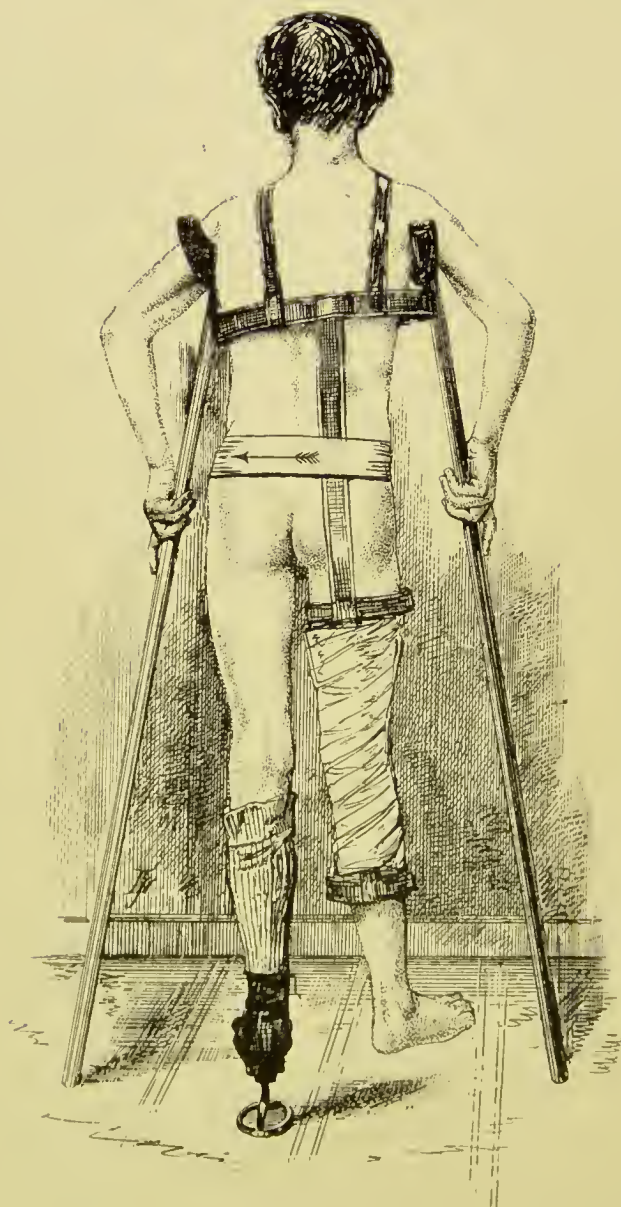
with flannel from the calf upwards, beyond the small crescent B, *plate 4, fig. 4.*

*Fig. 2, plate 4,* shews how the appliance should fit, when applied correctly; the long portion of the upper crescent being close to the trunk, the short portion a little space from the trunk. This is necessary to hinder rotation of the instrument, and the upright stem should have a perceptible rotation outwards, as shown in *fig. 4, plate 4,* from B to C, and be fitted so that it passes to the inner side of the poplited space as indicated by the arrow in *fig. 2, plate 4;* this will avoid rotation inwards of the limb, a defect easily avoided by attending to these details.

It is advisable that the sufferer should be confined to bed for a short period, at the commencement of the treatment, until the night pains and disturbed sleep have ceased—as in *plate 2.* This is the *first stage* of the mechanical treatment.



PLATE 9



Prescribing for the general health is occasionally required. The surgeon being satisfied that suppuration has been avoided.

Now comes the *second stage*. The patient is allowed to go about with the assistance of crutches, the frame continued, and an iron patten placed under the shoe of the sound limb, as in *plates 9 and 10*. These must be continued until the limb is well atrophied around the great trochanter.

We now come to the *third stage*. The patient takes off the framework in bed, and replaces it during the day, still using the crutch and patten for a certain period.

We now arrive at the *fourth stage*. The patient discards totally the frame, and uses the crutch and patten only. These he sets aside after the surgeon is well satisfied of the permanence of the cure. If the case does not progress to the surgeon's satisfaction, some of these stages must be prolonged.

The weight of the limb is equal to reducing any angular deformity of the lower extremity, and capable also, in a slight degree, of diminishing any shortening, should absorption of the head of the bone occur,—provided a suitable mechanical arrangement is applied.

The splint ought to be applied at once, whatever the stage of the disease. Forcible flexion, extension, tenotomy, or chloroform, &c., are to be avoided as injurious. In the presence of this method, these operations are objectionable, though they were essential at one time. Even should the deformity be an extreme one, no violence must be attempted; the limb must be gently persuaded to come back from the erring position, and as the limb assents, the wrenches shewn in *plate 8* should be used to alter the hip instrument towards the normal lines.

In illustration of the efficiency of this method I shall record a few cases, confining myself to strictly typical ones, as it would answer no practi-



cal purpose to burden the treatise by the record of a host of cases, most of them being but repetitions.

*Case No. 1.*—On the 17th of April, 1872, one of the sisters of a neighbouring convent, accompanied by a child, aged 12 years, (*Miss D—*) consulted me regarding some pain which the latter suffered in the right thigh. On making an examination, by the previously explained method, I was convinced that she had some slight inflammation of the hip joint, and I advised a delay of two weeks while the guardians of the patient should be communicated with, the patient to be confined to bed in the meantime. In the course of a few days I received a message that the patient was much worse, and on visiting her, I found that the joint was in a state of acute inflammation, and very painful, accompanied by a good deal of constitutional disturbance, and the local symptoms, usually present, intensified. I counselled no further delay, and with the con-

sent of the superioress of the convent, applied the frame, and fixed the joint, retaining the patient in bed for twelve weeks, at the expiration of this period, the local symptoms subsided, and could not be detected, except on rough manipulation. And during the first three weeks the febrile condition was treated with salines, &c., in addition to the mechanical treatment. At the expiration of the twelve weeks she was taken from bed, much improved in health, and stouter than she had been previous to the attack. During the next six months she went about with crutches, frame, and patten, as in *plate* 10. Afterwards, for a further period of three months, she continued the use of the frame in the daytime only, at the end of which time the patten and crutches were used during the remainder of the twelve months that she was under my care.

This case progressed well, and the patient recovered perfectly; and at the expiration of the treatment was in better health than she

PLATE 10





had ever been at any previous period of her life. During the progress of this case towards recovery, there was neither inversion, eversion, adduction, shortening, nor lengthening, at any time; nevertheless at one period in the treatment, I had some fear that there would possibly remain some amount of adhesion, and consequent stiffening of the joint, impeding its future action, as the inflammation was more rapidly developed and acute than any I had ever before witnessed in this class of cases. But it did not occur, and it is my opinion—and this is quite consonant with reason—that the more effectually an inflamed or irritable joint is fixed, and the sooner this is done, the greater is the certainty of its future freedom of motion and the absence of defects.

No rule can be laid down as to how long a joint ought to be kept under treatment. The surgeon must judge, by the disappearance of the symptoms of disease, when to alter and discontinue his treatment.

Stiff joints are not the result of too long confinement in an immovable position, but rather are caused by permitting movement, too soon, that is, before all inflammation has subsided.

It matters not from what causes these affections arise, whether from an injury, rheumatic attack, or a constitutional defect, the main thing needful is, that the joint be mechanically fixed, the general health being attended to, if necessary.

*Case No. 2.*—On the 18th of February, 1872, *Mr. J. D.*, of Cumberland, brought his son, a boy of eight years of age, to this town to consult me respecting a lameness affecting the left limb. On examination I found flexion, to an angle of about 150 degrees, of the hip joint. I consider this to indicate that the joint had been unsound for at least five months. I advised the use of my hip appliance, with the patient confined to bed. This was done, and had the effect of removing the flexion of the thigh by the end of the second week. He remained in bed twelve weeks, at the expiration



of which period, I found the affected joint had become normal in appearance. He was now permitted to get up, using the frame, patten, and crutches, as in *plate 10*. These were continued for another five months; then the frame was set aside, and his recovery was, by the end of another four months, completed. In this case no constitutional or local medical treatment was adopted.

This patient did well, although his early treatment had been very unsuitable, as he had been treated for a dislocation, by a bone-setter in the neighbourhood of his home.

*Case No. 3.*—In July, 1867, *Mr. J. G.*, of Aberayron, consulted me concerning his son, a boy six years of age, whom, on examination, I found suffering from *morbus coxæ*, with an amount of flexion 150 degrees, indicating, to my mind, an inflammation of five months' duration, with some amount of thickening around the joint. I adopted in this case my previously described

treatment, carefully fashioning the frame to the trunk and limb, and sent the patient home, directing him to be confined to bed, and to return in three months. At the expiration of that time I again examined him, and found the deformities, usually present at the fifth month, gone, the health moderate, but some thickening remaining around the trochanter; consequently, I feared suppuration would occur. I again sent him home, and advised his continuing in bed for two months longer, and on his return after that time, I found that the limb had continued to improve, with no sign of suppuration. I now allowed him to go about with frame, crutches, and patten, desiring him to again return in three months; and on his return at the expiration of that time, I allowed the frame to be removed in bed, and replaced in the daytime, with crutches and patten; and on his last visit, in 1869, I ordered the removal of all apparatus, and the boy was effectually cured.

In this case we have a patient treated at a distance from the surgeon—which course I have often had occasion to adopt—yet, by simply continuing the mechanical method, the case did well.

Children from the age of one to ten years can be very successfully treated thus. Travelling at this early age is not such an obstacle to their progress towards recovery, as it often proves in the case of adults.

The patient ought never to be allowed out of the frame, except under surgical supervision; should the patient be taken out of the frame, and happen to assume a sitting posture, and thus move the limb from the straight line with his trunk, he must retard the recovery, and, possibly, may undo the repair of months, and have suppuration set up at a late stage, a disaster he might otherwise have avoided.

At one period in this case I feared suppuration, yet from the absence of persistent pain, I judged he might escape this evil. A notable sign of

suppuration is, that from about the fourth to the sixth month of treatment, a rapid increase of pain is developed, lasting from seven to thirty days, with an almost sudden cessation, in one or two days, through rupture of the joint, on one or both sides of the ilio femoral ligament. The contents of the joint escape in this direction when the limb has been retained immovably in a line with the trunk.

*Case No. 4.*—In January, 1873, I was consulted by *Mr. N——*, *B—— R——*, in this town, concerning a slight lameness of his son, a boy eight years of age. The lameness only had attracted the parents' attention. But on applying my diagnostic method, I concluded that he had had hip disease for three months. The parents denied its having been so long; but on more careful consideration concurred, after a few days, with my view of the matter. I commenced the treatment in this case, by applying the frame, as usual, and by confining the patient to bed at night, and

to a couch during the day ; and as there was some amount of thickening around the joint, and pain continuing for a long period, I was convinced that suppuration would occur, and I directed that the patient be retained, in a horizontal position during six months. He required occasional constitutional treatment. At the expiration of six months the night pains, which had not previously troubled him, commenced to disturb his rest, and during the seventh month I detected fluctuation, and aspirated the abscess, which lay under to the skin over the anterior aspect of the hip joint. A second aspiration was made in two weeks afterwards, which operation was repeated every month, in all, six operations, after which the abscess ceased re-forming. Now he commenced to go about on crutches, with the frame and patten. Gradually the joint became atrophied, and he progressed favourably to a recovery, without any defect. Yet, I advised the continuation for a longer period of the

mechanical aids, so as to ensure the avoidance of a relapse.

This patient, though requiring some attention to his general health during the early period of the complaint, became possessed, in the latter part of his recovery, of most excellent health.

Since practising this method of fixing the joints, on no occasion have I had to give the patient an opiate.

*Case No. 5.*—In the early part of 1873, *Mr. P*—, residing in Cheshire, called on me, requesting me to visit and examine his son, a boy of about seven years of age. On doing so, I found him suffering from inflammation of the hip joint, of four months' duration, general ill-health, much emaciation, and want of sleep from night pain. I proposed immediately to fix the joint, telling the parents that this would itself restore sleep and appetite. The parents consented, and I applied the frame on the 18th of February, 1873. In three weeks' time the night pain had gone, the



appetite had improved, and the boy rapidly gained flesh. The local tumefaction around the joint did not subside, and as some tenderness remained when the patient was gently manipulated, what I expected occurred: an abscess formed on the anterior aspect of the thigh, which I aspirated once a fortnight for six weeks, afterwards once a month for three months. The repeated formation of the abscess, necessitated his confinement to bed during the long period of nearly nine months, at the expiration of which time he commenced to go about with the patten and crutches, which I advise in the second stage of treatment. This case also recovered without any defect or deformity.

*Case No. 6.*—In July, 1874, *Miss M. R.* consulted me, being desirous of having a deformity of the hip joint improved. On examination I found that the angle which the thigh formed with the pelvis and spine was a right angle, so that she could only reach the floor with her

toes by arching the spine considerably and leaning to the affected side. I also noticed, that there were several cicatrices, indicative of abscesses, at a previous period. The integuments between the ribs and the pelvis, formed several folds by long inclining to the deformed side. She had suffered at an early age from hip disease, and was now beginning to have a return of the acute symptoms. She was much emaciated, and appeared in general ill health. I advised her to undergo a few months' treatment, especially as she had, at times, much pain, which was the principal cause of her deteriorated health. Acting on my advice, she entered my hospital on the 15th of August, 1874. As the case was one of many years' standing I decided to model a frame to the deformed side (which I do not advise in recent cases), and as the case progressed, the spine straightened and the limb became more extended. I used the wrenches—*plate 8*—to alter the form of the

upright portion of the frame.—This modification is absolutely necessary in cases of long standing. In sixteen weeks the patient's shortening was gone and the spine was straight. I now advised a change to her native air in the Principality.

My hospital assistant having mislaid the notes of this case, I wrote to the patient, and requested her history of the period of her suffering. I lay before the reader her note :—

“DRWS REFAIL,

“ABERWCH, *April* 25, 1875.

“DR. THOMAS,

“DEAR SIR,—I am happy to say that my health is  
 “better than it has been for a long time. I am getting  
 “to look so well that you would not think I was  
 “the same person that entered your hospital on the 15th  
 “of August. My back is not so painful now. The  
 “creases in the left side have almost disappeared. My  
 “back is quite flat on the splint now. The doctor  
 “could not push his fist, as he used to do, between my  
 “back and the splint. I can put the other knee up to  
 “the chest quite easy now. I am still wearing a thick  
 “boot, and using crutches. I was afraid of leaving them  
 “off without your permission. You wished to know, sir,

“how long it is since I have been bad. Mother says  
 “that an abscess formed in my hip about twenty years  
 “ago, after scarlet fever; and then I had a fall about  
 “three years before I came to you, sir; and after that  
 “I had more pain than I had before, when walking.  
 “I do not think I can explain myself any better.

“With kind regards from, yours ever,——.”

In my early practice I often placed (and I believe it is the practice of others in cases of this character) the patient under chloroform, divided the contracted tendons, and forcibly extended the limb—a process which, though not very risky to the patient, is very painful. Yet, since I have practised this expectant method, of allowing the body to become unfolded by mere position, the patient has had no pain, and the result has been all that the surgeon could desire, and has not necessitated as much time as the previous practice. The deformity here was great, and had existed fifteen years, at least; this case was a crucial test of this method.

*Case No. 7.*—J. P., fourteen years of age, was





brought to me by his parents, in May, 1875, suffering from diseased hip joint, at the destructive stage, abscesses having formed, and sinuses communicating with the joint.

*Plate 11* is a carefully copied engraving of the photograph of the patient taken after eight months' treatment in a large hospital, previous to my examination of him. On examination I found the patient in the condition which is so well illustrated by the artist, namely, with flexed thigh, and curved spine, with large abscess and ulceration over the trochanter, and inability to reach the ground by three inches. This boy had the best of advice during eight months. The disease had existed about one month previous to his admission into the charity. The treatment he had received, was, from his own report, the long splint, at first, and latterly the weight and pulley.

This patient was placed in my appliance, and in the short space of three weeks all deformity



had been removed, and he was free from pain, but will require a long period to become sound.

I admit that abscesses, and some amount of destruction may occur under any method, but I also assert, that to whatever stage the patient progresses with my method, his recovery will be without deformity at least.

*Case No. 8.*—In the early part of 1874 I was requested to visit *Miss D*——, 14 years of age, who resided in this town, and who had suffered from lameness for five years.

On making an examination, I found that she had been suffering from disease of both hip joints, which had terminated in the formation of abscesses and sinuses on both sides. The joints were acutely tender, and flexed to an angle of about 140 degrees, the spine greatly curved, and she was unable to stand upright. Her history was, that five years previously she had slipped in the street, had injured her left hip, and from that time had

commenced to limp slightly—gradually more so. In one month after this slight accident she consulted a surgeon in this town, practising as a specialist in this department, who advised her rest and medical treatment (not surgical assistance). Not satisfied with this advice she consulted another surgeon, who advised rest and linaments, codliver, &c. In nine months after the accident the right limb began to suffer. At about the twelfth month she was placed under the care of a homœopathic practitioner, but the deformity, which had been increasing, now became stationary, and continued so for four years. At the termination of this period, a little over exertion brought on the acute symptoms again and I was consulted. I advised her being placed in an horizontal fixed position, and in twelve weeks both her limbs became unfolded from the trunk, and the patient became quite straight.

In this case, during five years, there was no attempt at any mechanical assistance, though

she consulted a specialist. When I saw the patient she was much emaciated, and the parents at first were not willing to have her confined to bed; but her being confined to bed, and having the joints fixed, had the usual effect of giving her undisturbed sleep, an increase of appetite, freedom from pain, and a rapid gain of flesh.

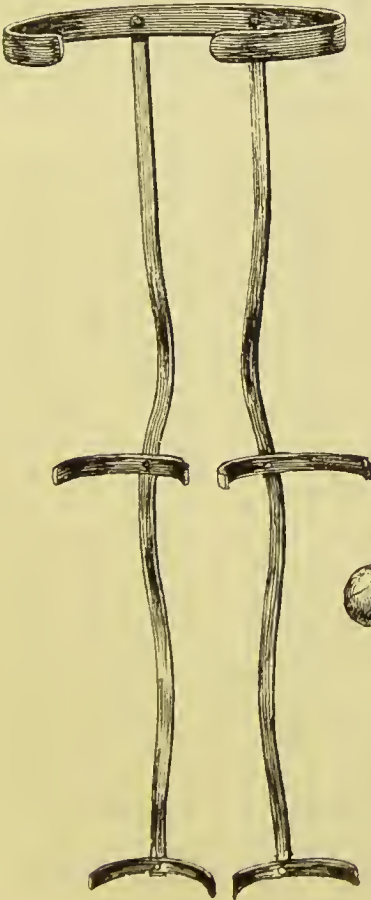
In this case I had to place an upright on to each limb instead of on one, and I have always found it much easier to fit and retain the hip instrument with two perpendiculars to it than with one (as in *plate 12, fig. 1*).

*Case No. 9.*—In May, 1868, I was consulted by O. E., a lumber merchant of Utica, United States. He had brought his son over for assistance in a case of flexed hip joint, the result of inflammation, followed by suppuration, and the sinus formed had not yet ceased discharging pus.

In this case I put the patient through my usual treatment, and he remained in town for

PLATE 12

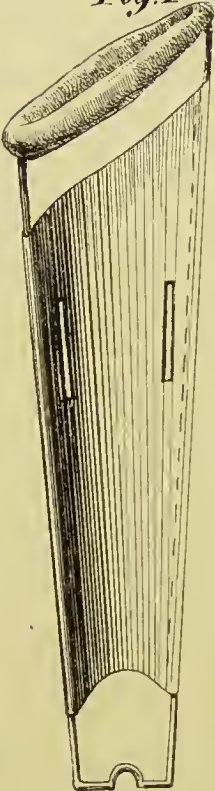
*Fig.1*



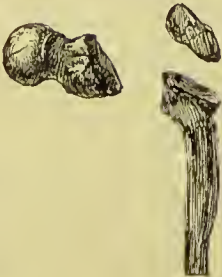
*Fig.2*



*Fig.4*



*Fig.3*



*Fig.5*





two months by my advice. He was then taken to the Principality for some months, and again consulted me on his way home to the United States.

I instructed him how the treatment was to be continued, during certain periods, and his report to me in 1871, was that of perfect recovery. He had had skilful assistance from United States surgeons, previous to his being brought over, but with deformity and unsound result.

*Case No. 10.—James H—*, Dalton Furness, aged eighteen years, consulted me on July 1st, 1874, suffering from a pain, lameness, and deformity of the left hip joint. On examination I found also the usual symptoms of formation of abscess. The history of this case was that two years previously, he had met with a slight accident to the hip joint, and as some lameness remained, he consulted a surgeon in this town, who advised alkaline formentations, cod liver oil, and other remedies that are prescribed by surgeons

who take a diathesis view of nearly all chronic joint affections. This treatment he had continued during two years. I advised that he should enter my hospital, and be placed in the horizontal fixed position, which had the usual effect of improving his health and appetite. As soon as he had become well fixed, and settled in the instrument, I aspirated the joint at intervals of two weeks, until the 10th of September, when perceiving that aspiration would not succeed in controlling the formation of pus and drain on his constitution, I laid open the abscess with an extensive incision. The abscess continued to discharge more or less until the latter part of November, when he became decidedly hectic, and exhausted from the drain of pus. I decided to excise this joint, which I did by the method explained in *plate 12, figs. 2 and 3*. I made Sayre's semi-lunar incision through the soft structures, exposing the bone ready for the saw, then taking a fine-bladed keyhole saw, I sawed



off the top of the great trochanter, leaving it attached to the rotator muscles ; then passing my finger into the depths of the wound and feeling for the lesser trochanter, I placed the saw on the front aspect of the femur, just above the lesser trochanter, and sawing through the femur, easily removed the head and neck and a portion of the shaft (as seen in *fig. 3, plate 12*). I found the head of the femur carious, with a perforation of the acetabulum, through which about ten ounces of pus escaped. The operation was successful in temporarily relieving the constitutional infection he had suffered for some weeks previously, but did not arrest the drain and increasing depression, and the patient succumbed in twenty days after the operation.

In this case the operation was imperatively demanded, and I was prepared for a very extensive amount of disease, as the patient had had no rational treatment for nearly two years,

and had made use of the limb to some degree daily, though not in any employment.

I performed the operation on this occasion, deviating from the methods hitherto practised by leaving a portion of the great trochanter. The usual justification for removing the trochanter and head of the femur, is that it facilitates drainage from the wound. This modification of the operation, leaving the great trochanter, would not interfere with the drainage from the joint, and I judged it to be quite as rational a course as that of leaving the calcaneum in Pirogoff's operation, and calculated to assist in developing more bone in the place of that removed, and to re-unite to the shaft of the femur.

*Plate 12, fig. 2*, shews the course of the saw through the bone. My limited experience of excision of the hip joint, derived mainly from what I have observed in the practice of others, convinces me that it is not an operation desirable,

except as a last resource, where all means have failed to control the disease, and when the patient is suffering an amount of irritation, that must be fatal if not relieved. This operation, which, by surgeons of the United States, is looked upon as involving but little risk, has been performed, according to their own evidence, upon patients whom I should consider amenable to treatment, with a fair presumption of success, and accounts for their dictum, that the operation involves no risk, for no doubt the patients frequently operated upon were far from an advanced stage.

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## CHAPTER III.

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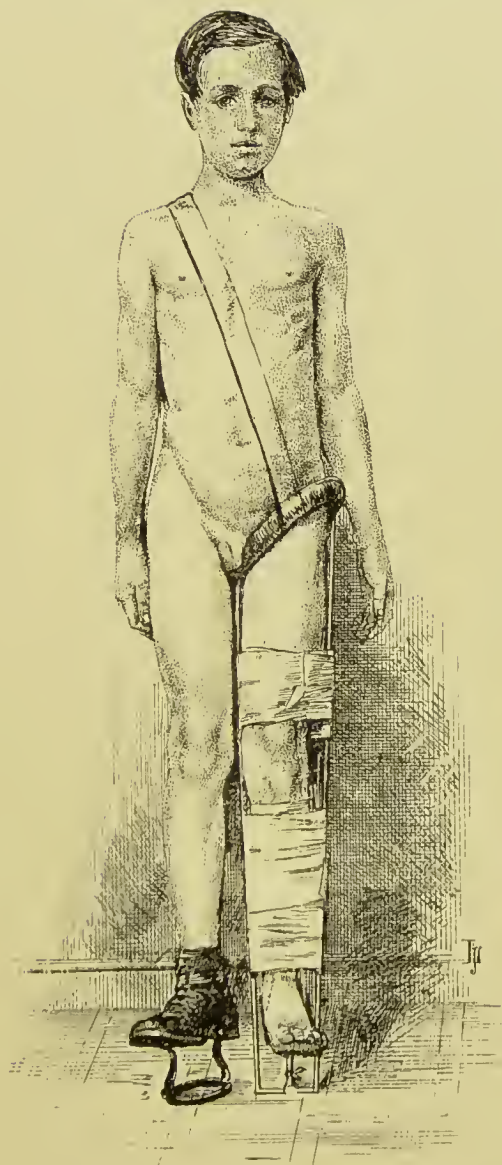
### DISEASES OF THE KNEE JOINT.

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THE method of fixing, and taking off all concussion, and of arresting friction, as applied to diseases of the knee joint, is even more satisfactory, and more rapid in its curative effects than in hip joint disease. By it, we are enabled more effectually to control the joint, and the patient is enabled at a much earlier period to go about, and frequently becomes able to attend to his usual avocations, long before the knee has recovered.

As in hip joint disease, so here, position and weight of the limb is sufficient to remedy any deformity, not the result of true ankylosis,

PLATE 13





and the slight extension, in the rare cases where it has been made use of, has been with the intention to retain the limb between the bars.

Excision of the hip joint has not been a popular operation amongst surgeons in this country, but they have made up for their lack of zeal in this particular, by a too frequent condemnation to excision affections of the knee joint.

Many cases thus condemned, which certainly had not arrived at the stage of joint destruction, (but were amenable to successful treatment,) have come under my notice.

The appliances employed in this treatment are shewn in *plate* 12, *figs.* 4 and 5. The upper crescent is formed of a ring of iron  $\frac{3}{8}$ ths of an inch thick, and nearly an ovoid in shape, covered with boiler felt and basil leather, from the upper and lower portions of which, two iron rods pass down to the lower end of the machine, where



may be noticed a small staple for retention purposes, in the commencement of the treatment. This staple is cut off at a subsequent stage, and replaced by a patten, as in *plate 4, fig. 7*, which is welded on, in its place, for the use of the patient in locomotion. Across the two parallel bars are stretched an apron of basil leather to support the limb, in which are two slits for the insertion of the bandage—*plate 12, fig. 4*. The patten, which is worn under the shoe of the sound limb in locomotion, is shewn in *plate 12, fig. 5*. An exact diagram and side view of the nearly ovoid ring is shewn in *plate 4, fig. 3*, from which the reader will perceive that the anterior crescent E, is somewhat straighter than the posterior one D, and that the inside stem G, is connected anteriorly to the centre of the nearly ovoid ring, the stem A being connected to the centre of the top of ovoid. The stems of the machine should extend for at least three inches below the foot.

I will here again introduce a few typical cases, of special interest as having been crucial tests of the efficiency of this method of cure.

*Case No. 1.*—In May, 1872, I was consulted by *M. P.*, of Dalton-in-Furness, twenty-six years of age, who was suffering from chronic inflammation of the knee joint. He had been a sufferer and unable to work for nine months previously. There were the usual symptoms of chronic inflammation, but no effusion; the knee was contracted to an angle of about 160 degrees. The symptoms not being acute, the knee machine, *fig. 4, plate 12*, was fitted, with a patten end attached, as in *plate 4, fig. 7*, and the usual patten under the foot of the sound limb. From the date of the appliance being fitted, the patient went about daily, with no treatment other than an occasional aperient, and firm bandaging to the machine, which he retained night and day for twelve months. This man's recovery was perfect.

*Case No. 2.*—On the 10th October, 1873, Mr. S—, of Workington, brought his son, a child, four years of age, to my hospital for examination and advice. I found him suffering from disease of the knee joint at the destructive stage. Suppuration existed, and there were several sinuses discharging pus, and the leg was contracted to a right angle with the thigh. The hamstring tendons were tenotomised under *æther*, and a safe amount of force was used to extend the knee, but without success in totally removing the angularity. The patient was then placed in the machine, with a staple attached for retention.—*Plate 4, fig. 6.* A very gentle fixed retention in the machine was continued for four weeks. At the end of this period, the limb was perfectly straight, and the child ultimately recovered.

In this case the adhesions were so strong, that a justifiable amount of force was not

sufficient to tear them, but four weeks of uninterrupted retention between the parallel rods, without any posterior leather support, sufficed to straighten the limb. Tenotomy was performed in this case, believing that it would shorten the period required to diminish the deformity. In this I was wrong, and the case convinced me, that it made no practical difference, after this I totally laid aside this operation in knee cases.

*Case No. 3.*—In March, 1872, I was consulted by *Mrs. H.*, thirty-two years of age, residing in London, concerning a chronic state of inflammation of the knee joint, which was contracted to an angle of about one hundred and forty degrees. She could make but very little use of the limb, and suffered continuous pain night and day.

The history of this case was, that when about eleven years of age, she fell and injured her knee, and was placed under the care of a bone setter in the neighbourhood of Wakefield, who pro-

nounced the case one of dislocation. She was under his care up to the age of nineteen, when she consulted a celebrated bone setter in this town, who advised the counter irritants in vogue in those days, but with no benefit. In the year 1862 she consulted me. I prescribed the usual remedies taught in our schools, but with no beneficial results. Soon after, having removed her residence to London, she had the assistance of a professional gentleman of the highest reputation and skill, and who deservedly stands at the head of the profession. His advice, however, was followed by no improvement of the limb, nor any diminution of the pains and other signs of local irritation.

I was consulted by her again in the early part of 1872. At this time I was practising my new method of treating such cases, and had used it successfully for some years. I advised a trial of this method of treatment. The machine was applied with the patten, as shown in *plate 13*.

No retention arrangement was used, but merely posterior support with leather across the bars, and flannel bandages. The limb, which had been flexed at an angle of one hundred and forty degrees for several years, in four weeks was perfectly straight in line with the thigh. With the aid of the machine she was enabled to go about, and attend to her duties, &c., and at the expiration of the third year of wearing it, the joint being perfectly sound, she set it aside, and its disuse has not been attended with any signs of relapse. A slight degree of stiffening remains, which is an advantage towards her recovery; moderation however, in the use of the limb will remove it. Had passive motion been employed to overcome this, I feel assured that it would be an invitation to a return of the disease.

*Case No. 4.*—In June, 1875, *E. W—*, residing in London, was brought to me by his parents, for advice. He suffered from

chronic inflammation of the knee, accompanied with an enlargement, and an angular contraction nearly at a right angle with the thigh. There was no effusion and no suppuration, but tenderness on manipulation. His appearance has been well depicted by the artist in *plate* 14. From the history of the case, I found that he had been a sufferer for nine months, and had had skilful assistance from a surgeon, in one of the hospitals in the metropolis, specially devoted to these subjects. It had been decided to excise the joint. I applied my new instruments with the staple end for retention, bandaged the limb, but omitting posterior support. The result was that the limb became perfectly straight in ten days, and quite free from pain. By this time the child was able to walk about, with the additional aid of the patten under the sound foot, although he had not walked for nine months previously.

Without wishing to reflect upon the earlier







treatment of this child, the new method proved of more benefit to the limb, in ten days, than the old method had in nine months. It enabled the child in a few days, without pain or distress, to go about, and that without the aid of crutches or walking-stick.

*Case No. 5.*—In October, 1872, *Miss H—*, of Bootle, nine years of age, was brought to me by her mother, suffering from inflammation of the knee joint, which had existed for twelve months. There was a good deal of effusion, and tenderness of the joint, with flexion to an angle of one hundred and forty degrees, and consequent lameness. The patient did not seem to be suffering constitutionally. She had been for twelve months in this condition, though she had had skilful assistance. I advised the use of the instrument, and the application was followed by the limb becoming straight in six weeks. The effusion diminished but slowly, occupying a period of nearly three

months; there was no extension or retention practiced in this case. From that time up to the present all trace of the disease has disappeared, leaving no stiffening. I advised, however, a continuation of the appliance a little longer, to confirm the recovery.

I frequently omit retention, except in cases under five years of age, where it must be continued during the whole of the treatment, otherwise the patient, at that early age, not seeing the necessity of the treatment, will take off the instrument, or make attempts to wriggle out of it, but the arrangement for retention renders this impossible.

This patient was placed in the appliance when partially ankylosed, and retained in it for three years continuously; yet was found at the expiration of that period with the movements of the knee restored.

*Case No. 6.*—In February, 1871, whilst making a professional visit to *Mr. H—*, of

L— Street, in this town, I noticed that his daughter, *Miss A. J. H—*, twelve years of age, was a cripple, and on inquiry I was informed that when only 12 months old she had a fall, and from that time commenced to be lame. This lameness continued to increase until she was twelve years of age. Upon examination, I found that her knee had suffered for a long period from chronic inflammation. There existed at this time a partial dislocation of the head of the tibia, from the condyles of the femur, and excruciating pain on slightest manipulation, with a right angle flexion. Although this case had not gone on to supuration, yet during the whole of that time it had been more or less tender, so as to incapacitate the sufferer from even the use of crutches. I volunteered to do what I could to relieve her. I put on one of my appliances, with staple for retention, which she wore for six months and then exchanged it for one with a

patten at the end, as in *plate 4 fig. 7*. Her condition at present is represented in *plate 15*, taken from a photograph. The left knee, although not perfect, she is able to use with some defect of motion. During the time the patient wore the machine, she attended to her household duties. Some defect must ultimately remain in this case, as twelve years of neglect cannot be expected to be totally made up for.

*Case No. 7.*—In January, 1869, *Miss M. J.*—, came from Palestine to consult me. She was suffering from chronic inflammation of the knee joint of long standing. The joint was enlarged, slight effusion, very tender, and angular flexion to one hundred and twenty degrees. The patient much emaciated, and in depressed spirits and ill health. Her history of the case was, that in the winter of 1856 she fell on the ice and injured her knee. She received no professional assistance for six months, and on consulting a doctor he



PLATE 15







pronounced it a dislocation of the knee cap, but that it was not possible to reduce it. After this she consulted several doctors and bone setters in search of relief, but in vain. In 1859 she was taken to the Queen's Hospital, Birmingham, from whence, after a period of two months' treatment, she was discharged much relieved, but not quite free from pain. This improvement continued for three years. In 1864 she went on the Continent, and whilst abroad in that year was laid up in bed for three months with a return of her previous symptoms. She was again relieved, and able to travel for twelve months.

In 1867, while at Jerusalem, she had a return of all the previous symptoms intensified. This attack continued for four months, and, not being able to get sufficient relief to enable her to attend to her duties, she returned to England for the purpose of consulting me.

I applied the machine with patten attached ;

no retention was used, but leather across the bars and flannel bandaging. I also prescribed to promote her general health. She was so much improved in six months that she commenced to travel the country as a public lecturer in connection with the Canaan Mission, and continued to do so for three years, at the expiration of which time her recovery was complete, though with a stiff limb. She reports to me now that she can walk many miles per day, without feeling the least distressed.

The improvement of her general health was rapid after the first six months. There was an unusual amount of stiffness remaining in this case, which is not to be wondered at, when the many repeated attacks of acute inflammation she had suffered from during the previous fifteen years are considered.

This was the first case in which I applied this machine to an adult. I had been using it for children for some years previously.

*Case No. 8.*—In January, 1865, *Master J. W*—, of Bootle, seven years of age, was brought to me by his parents, suffering from a diseased knee joint.

On examination I found that suppuration had occurred, and that there were several sinuses communicating with the joint, one through the popliteal space, and several on either side of the joint. I had never before seen so much apparent destruction of the articulation. There was also flexion to a right angle.

The history of the case was, that in consequence of a fall the knee became attacked by acute inflammation. The patient had been placed under the care of a bone setter in this town, and his son, a surgeon, who profess specialism in this department.

The usual methods of treatment had been adopted up to the period when I examined him. With the consent of his parents, I decided to place him in one of my new appliances with retention,

cutting out from the leather stretched across the rods a sufficient opening to admit of the drainage from the knee. The limb soon became straight; the leg was bandaged with flannel, inclusive of the machine, up to the knee and from thence to the thigh, but leaving the knee exposed. The only treatment applied to the knee was frequent washing with water, and a little cotton and oil to prevent the opening in the joint from scabbing, and the joint becoming distended with pus. It is too frequently the practice to surround the joint with a poultice or a mercurial ointment, a proceeding very injurious, and a remnant of the surgery of the middle ages.

The patient was under treatment for five years; during this period he had an attack of kidney disease on one occasion, and fever on another.

This case ultimately attained a perfect recovery. *Plate 16*, taken from a photograph,

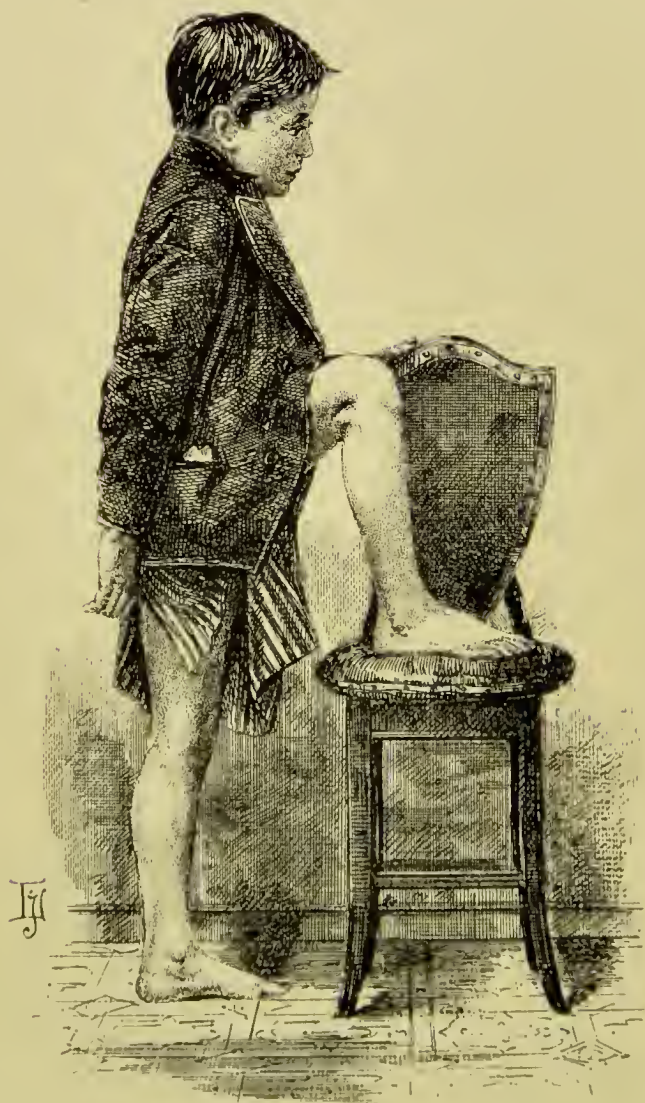








PLATE 17



shows the boy standing ; *plate 17* shows him with the knee extremely flexed. These two plates enable the reader to see what amount of action the knee possessed, and the extent of its recovery.

The case was very complicated at one period of the treatment, owing to the kidney disease and typhus above adverted to. This did not, however, induce me to interrupt the treatment of the knee, for had this been done the patient would have had the additional irritation of the knee to suffer from, and must have certainly succumbed to the twofold disturbance.

I have always objected to removing the appliances in such complicated cases, as the additional irritation of the secondary complaint, superadded to the existing disease, if neglected, would much diminish the patient's chance of recovery.

Here we have a case of knee joint disease

with partial ankylosis, placed under uninterrupted enforced rest for five years, at the end of which period there was diminished ankylosis, and finally at this date, 1875, the patient recovering, with perfect motion and use of the joint.

*Case No. 9.—Miss McG——*, from near Kirkinner, Wigtownshire, consulted me in April, 1872, suffering from splay foot of the right side. I noticed, moreover, that she also suffered from some lameness of the left limb, concerning which, however, she had no intention of consulting me. Perceiving that she was seriously lame on that side, I advised her to allow an examination of it. On thus examining I found that she suffered from an angular deformity of the knee joint with an extreme curve inward as in the ordinary knock knee. The joint was much enlarged and abnormally sensitive and stiff. I advised that the limb should be placed under surgical treatment, to which, after some persuasion, she

consented. The splay foot was first completely remedied and then her knee was placed in my usual knee appliance with patten under the foot of the sound limb, &c. The thigh and leg were so much diverted (knock-kneed) from the straight line that I had great difficulty in getting the limb into the appliance. The patient was in excellent health, requiring neither constitutional nor local prescribing.

The mechanical treatment was continued for two years, the lady returning to consult me at intervals of three or four months until January, 1875. The limb, which she had thought was beyond all remedy, had been so far relieved, that she was desirous of making use of it. It had become perfectly straight, the joint nearly normal in size, painless, and free from the stiffness which had characterized it when first placed under control, though it had not been released from the restraints, even for an hour, for two years, I advised her to

continue the appliance for some portion of this year, after which I have no doubt that the absence of restraint will, during the following twelve months, restore motion.

*Case No. 10.*—*Master R*——, of Pwllheli, Carnarvonshire, was brought to me, suffering from chronic inflammation of the knee joint, accompanied by a great amount of constitutional disturbance, joint enlarged with effusion, angular flexion to a right angle, and much pain, from which there was but slight remission day or night.

The history of this case was, that in April, 1874, the sufferer had received a slight injury, and not recovering at the expiration of three months, his parents consulted a bone-setter, now practising in the Principality, who pronounced the joint laxated, and who subjected the patient's knee to manipulations, so severe as must more than satisfy any of the distinguished modern converts to this antiquated barbarity; with the result of adding greatly to the patient's

local distress, and producing the constitutional disturbance under which he laboured.

These manipulations were followed by the standard local remedies, rubbing with oils, baths, iodine, &c.

He was brought to me three months after this effete method of treatment, and six months after the injury. This was in October, 1874. I first placed his limb in one of my knee appliances, and then attended to his general health, and he was taken home; when brought for examination again in three months he had greatly improved. I now advised the discontinuance of constitutional treatment, and the use of the limb controlled the machine in locomotion. On his return on the third occasion, in six months from the second visit, I found the knee sound and free from defect, normal in function, while healthy in appearance; yet I advised a continuance of the appliance for six months longer to confirm the cure, as experience has convinced me that six



months, though apparently in excess, is a lesser evil than a deficient period of restraint, which latter might result in imperfect recovery, or no recovery at all.

*Case No. 11.*—In June, 1874, *Mrs. B*—, residing at Santander, in Spain, brought her daughter, a child ten years of age, to have my assistance.

The child suffered from chronic inflammation of the knee joint, and right angle flexion, with acute tenderness and constitutional irritation. She had been a sufferer for nine months previously. The limb was placed in one of my appliances, and the knee joint aspirated, removing about one ounce of fluid. In the fourth week she was going about without assistance even from crutches, though her previous sufferings rendered “the crutch” indispensable when taking exercise.

This case stayed at my hospital four months, at the expiration of which time the joint was painless, there was no deformity, and the effusion

had not recurred. When she left the hospital she returned to Spain, and *Mrs. B*— reports her daughter as doing well, and not requiring any extra medical or surgical assistance.

In this case I was convinced that the pain was the sole cause of the constitutional disturbance, and I was confirmed in my view, for as soon as complete mechanical rest was established, the general health rapidly improved with no prescribing, and the angular deformity gradually resolved after positioning the limb, as in *plate 13*. This case was aspirated, an operation in my experience harmless, and one which can with safety be resorted to early with benefit to the patient.

I am glad to be able to add independent testimony to the value of the treatment here advocated, in the following case attended by my friend, J. P. Harris, of this town, who has kindly furnished me with the following particulars.

“*Case No. 13.—Elizabeth H—*, aged 30,”  
 “consulted me about six months ago for an affec-”  
 “tion of the knee joint. Her history is as follows:”  
 “About eight years ago she fell in going up”  
 “some steps, and slightly bruised the left knee.”  
 “She did not experience much inconvenience at”  
 “the time, as she used the limb afterwards,”  
 “though attended with some little uneasiness and”  
 “slightly impaired motion.”

“Six months later she obtained a situation”  
 “as a school teacher, where she was under some”  
 “additional exercise and exposed to cold and”  
 “damp. The knee became inflamed, and was”  
 “treated with leeches, blisters, rest being insisted”  
 “on. From this time the joint became more”  
 “stiffened, and nine months later an abscess”  
 “formed on the outer side of it, which discharged”  
 “for twelve months. The joint now became fixed”  
 “in a semi-flexed position, allowing her to walk”  
 “very imperfectly from the points of the toes with”  
 “the aid of a stick. Attacks of recurrent inflam-”

“mation of the joint continued to trouble her, and”  
“these deteriorated her general health very much.”  
“On the 11th of May last Mr. Thomas’ splint was”  
“applied according to his method. In about a”  
“month the limb resumed its naturally straight”  
“position, the joint becoming less in size and free”  
“from all tenderness, though somewhat larger”  
“than the opposite joint. The splint continues”  
“to be worn; and, by the use of the patten for”  
“the opposite foot, she is able to move about”  
“with comparative comfort.”

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## CHAPTER IV.

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### DISEASES OF THE ANKLE AND TARSAL-JOINT.

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AS the appliances recommended to be used in diseases of these articulations, are the same in model as those recommended for the knee joint, I will here merely introduce a few noteworthy cases of enforced rest, in the treatment of them.

Though the appliance is not so effectual in restraining the use of the ankle joint, as that of the knee, yet the cases which follow shew the benefits of the method.

*Case No. 1.*—In October, 1872, *Mrs. D—* of Ridgway, Iowa County, Wisconsin, U.S., came over to England to consult me concerning a lameness of the left foot. On examination I found a slight tenderness, with a little swelling and stiffness of several of the tarsal articulations. She was totally unable to place any weight on the foot. The ankle joint was healthy and in no way affected.

Her history of the case was, that she had strained the foot some seven years previously. She had consulted several doctors in the States; most of the gentlemen consulted concluding that there had been a displacement of the tarsal bones. The usual remedies were advised; and on one occasion she was subjected to violent manipulation, for the purpose of reduction of a displacement, believed by the practitioner to be present. She had also had applied a remedy that has not as yet found its way into this country, the Junod boot, but with no beneficial result.

On finding that she was suffering from chronic inflammation, I decided to treat her with my usual knee apparatus and patten, which was continued for two years. In the last communication I received from her, which was this year, she represents herself as having completely recovered, and that she had laid aside the appliance after two years' use.

The appliance worn in this case is shown in *plate 13*, but without the retention. In diseases of the metatarsal joints, a very excellent method is the application of the ordinary patten, *fig. 5*, *plate 12*, to the shoe of the sound foot, and placing the heel patten, *plate 4, fig. 5*, under the heel of the diseased foot, and so enabling the patient to go about without touching the floor with the anterior portion of the foot.

*Case No. 2.*—*Mrs. D—*, of Denbigh, consulted me in the month of December, 1873, suffering from chronic inflammation of the tarsal bone, which had existed six months. In this case I



advised constitutional treatment, cold douché, with painting of the skin with Tincture of Benzoin, to protect it from the irritation which, in her case, the water always produced. Under the heel of the affected foot was placed an iron clog, *fig. 5, plate 4*, with the usual patten under the sound foot. My instructions and mechanical appliances were continued for six months, with the result of perfect recovery.

*Case No. 3.* — *Miss R—*, of *M—*, near Llanrwst, consulted me in February, 1868, suffering from long standing chronic inflammation of the tarsal articulations. In this case the only application was strapping, (for the purpose of stiffening,) with adhesive plaister spread upon paper, and the foot appliance, *fig. 5, plate 4*. This treatment was continued for seven months and the patient recovered.

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## CHAPTER V.

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### ANCHYLOSIS AND ITS CAUSES.

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THERE are several difficulties which beset the surgeon in his attempts rationally to treat chronic diseases of the joints.

In the first place, an extended experience has convinced me, that it is, as a rule, easier to cure the disease than to remove the doubts of the patient and his friends, prompted as they too often are, by members of our profession, who ascribe to a faulty constitution the origin of nearly all joint affections, ignore all local restraint, and trust to counter-irritation, and specific medicines, applied externally and internally.

Joint diseases, like all other affections, present variations in each case. The patient's general health partakes of this variability, and requires careful individual consideration. Medicine may be required in one case, or its omission in the case of another may be necessary. Cases are met with requiring no prescribing, and consequently do better without it. When it is required, it is important, as the improvement of the general health will benefit the local disease.

Specific treatment utterly ignoring (as it too often does) the necessity for rest, omits the principal item needful to success.

What is usually meant by "rest" is confinement to bed, without any fixing of the joint.

In the case of hip joint disease such "rest" is of no value whatever. The patient sits up in bed many times during the day, and so flexes the limb more effectually than he would have done had he been going about.

Confinement to bed, in the case of knee joint

affections may be called partial rest; and in the case of the ankle joint is more effectual still; but in the case of hip disease it has no curative value, if not accompanied by proper mechanical control.

A second difficulty that frequently meets the surgeon is the solution of the question, What duration of time do these cases require for recovery? A month may be sufficient in the case of *A*, while the case of *B*, arising with the same symptoms and under almost the same conditions, might demand forty months. It is the duty of the surgeon to be certain as to the soundness of the limb, before pronouncing it fit for use. The period of treatment necessary to be consumed, being variable, can of itself be no guide to the formation of that opinion.

A third difficulty is the common belief that long continued fixation of the joint, in one position, by a splint or appliance, involves the risk of ankylosis. I notice this opinion

inculcated in the writings of an illustrious Pathologist, and one of the ablest men who has ever adorned our profession. In volume 1 of his "Clinical Lectures and Essays," page 93, article "Bone setting, &c.," we read :—

"With rest too long maintained, the joint becomes and  
 "remains stiff and weak and over sensitive, even though there  
 "be no morbid process in it, and this mischief is increased if  
 "the joint have been too long bandaged, and still more if  
 "treated with a cold douché. I need hardly say that it may  
 "sometimes be difficult to decide the time at which rest after  
 "having been highly beneficial may become injurious."

The "rest" here referred to is, practically, partial only.

The purpose of this article throughout is also remarkable, as showing how a surgeon possessed of the highest attainments and status in the profession, may be converted to the irrational practice of that class of practitioners, who even attribute their success in treatment to their absence of professional training.

A fallacy with the public, and a growing one

among the profession, of late years, has been that some unqualified practitioners are in possession of some occult art in this branch.

I have ventured to declare this a fallacy, after due consideration, having, during the early portion of my life, been intimately in the confidence, for years, of as many as seven of these manipulators, male and female, in various parts of England and Wales ; and, indirectly, frequently watched the practice of six such others, distributed over England, Wales, and Scotland.

In the sanctum of one I had the pleasure of meeting (incognito) one of our metropolitan professors of surgery in search of knowledge.

These opportunities have given me the right, and in the interests of the progress of rational surgery, I feel it my duty, to record the experience thus gained, which experience amounts to this ; that this class of practitioners are not in possession of methods “not dreamt of in our philosophy.”

Frequently I have heard patients express themselves relieved in twenty-four hours, when, as a practical surgeon, I could plainly see that they were still sufferers. I never met with one of these practitioners "but loved his trade rather than his art." Many of them are only successful competitors with shrines, relics, and other nervine remedies; and I certainly would not advocate the addition of even a genuine relic to the surgeon's armamentum.

Joints not controlled or when placed in what is usually termed "rest," if in a state of inflammation, become the seat of a degree of stiffness, which I can confidently state is not the result when joints have been fixed immovably.

At page 206 of the same volume a very interesting case is reported, as described by Professor Flower, which rather confirms my theory:—

"A man, whose skeleton is at Marburg, was encased by his relatives for 20 years in a space in which he could only sit with his limbs doubled up, and in which he could have



“had only very narrowly restrained movements of his joints ;  
 “yet his limbs did not become deformed, and his joints  
 “retained their normal textures.”

The Professor quotes this as an instance of exception to his own belief, but he omits to inform us whether the man's relatives wished to kill him or merely to stiffen him. If the latter, they certainly tried it according to the commonly supposed means, but one element was wanting—irritation of the joints. This would have assisted in stiffening his joints. But granting that he had this irritation or inflammation of the joints, and also been compelled to roam about, the ankylosis would have been a certainty, and instead of the experiment occupying twenty years, would most probably have been attained, and that most effectually, in one year.

Billroth in his *Surgical Pathology*, fourth edition, 1869, page 520, inclines to my opinion :—

“It must not be supposed that prolonged use of a  
 “gypsum bandage must needs produce a stiffness of the  
 “joint, the contrary is not unfrequently the case, namely,

“that a limb is found to be more moveable when the  
“apparatus is taken off than before it was put on.”

Another writer thus lamentably instructs  
us—Hood, page 113 :—

“It is also manifest that if permanent ankylosis be the  
“result arrived at by the surgeon, rest must be a necessary  
“condition for bringing it about.”

In confirmation of this he reports several cases  
of partial ankylosis from what is usually mis-  
called rest.

A third author in his article on the restora-  
tion of crippled joints gives his opinion thus—  
Barwell, chap. 17, page 378 :—

“Yet in strumous synovial disease, all inflammation  
“having ceased, my recommendation that passive motion  
“might be used, is often met by the question—‘Had we  
“not better wait till the tissues are consolidated?’ What  
“a strange query that is.. Wait till the joint is all but  
“immovable before we try to establish mobility? Wait  
“till the house is burnt down before we attempt to  
“extinguish the fire!”

My answer to this is that the practice he  
advocates is more like rushing into the house and  
attempting to occupy it whilst the fire is raging.

This author strongly advocates passive motion, which in my opinion is very rarely required.

In none of the cases reported by the two last authors was there complete rest of the joint. I believe consequently the cases most probably recovered with some partial defect, and were not in a condition gradually to enter upon their normal functions without manipulative assistance, if sound.

For many years I believed the dictum, and practised the method as laid down by these gentlemen, until its imperfections and deficient results induced me to attempt its improvement and finally to abandon it.

Two years ago I operated upon the feet of a lady suffering from contraction of the tendons Achilles, caused by the weight of the bed clothes during a long period of confinement to bed. The contraction had existed five years and totally prevented her locomotion, and she was consequently confined to a couch or bed during the whole of that period.

Ten days after the operation she walked from my hospital a distance of 800 yards, and rapidly recovered.

Although this joint had been fixed for a period of five years, there was not the slightest stiffness or adhesion in it. The stiffness was confined to the tendons Achilles only.

I had occasion during the same year to operate upon the feet of a young lady who had been confined to bed for three years from the same condition of the tendons Achilles. As in the previous case, she was totally unable to walk or to place her feet upon the floor. In six days after the operations she went about. There was no evidence of ankylosis. Ankylosis will occur in a degree always relative to the inflammation present, and the imperfect fixation of the joint prolonging this inflammation. Whatever stiffness occasionally remains, even after the fixation of a joint, that stiffness would have been still greater after deficient fixation.

It has been my practice in certain cases of paralysis of the extensors of the hand to place the hand at nearly a right angle with the forearm in the position of extension, and to continue this for six months without a moment's relaxation or intermission. Yet this amount of fixing has never in any case produced permanent stiffening, as the one thing necessary was absent, namely: internal irritation or inflammation. A relaxing rather than a stiffening has, as a rule, been my experience.

When joints that were contracted and in a state of chronic inflammation, and falsely ankylosed, were retained fixed without intermission for two years, they became relaxed more and more as the joint improved, as in the knee joint cases, Nos. 5 and 8, previously reported.

The more an inflamed joint is fixed, the sooner the inflammation subsides, and consequently the less the damage done and the better the result.

Passive motion, so frequently urged in surgical text books, is pregnant with danger to the patient, and often undoes what the surgeon had otherwise well achieved.

When once the joint is well, let the restraint be removed, and the part will, with rare exceptions, regain its utmost usefulness through use alone in the majority of cases.

A certain amount of stiffening which remains for a time, assists in confirming the cure by preventing the patient making too free a use of the limb.

It often happens that ankylosis in a greater or lesser degree impairs the ultimate cure. In these cases the surgeon can boast of having saved the limb and perhaps the life of the patient.

My experience compels me to disbelieve the possibility of ankylosis, where there has been complete mechanical rest, and not an inordinate amount of inflammation.

There is yet one more feature of joint disease that requires notice, namely: Wasting of the affected limb. And as evidence of the opinion held by the profession, I cannot do better than quote from the 6th chapter, vol. 1, page 209, of Sir James Paget's very valuable contribution to medical literature:—

“It seems dependent on disordered nervous influence, “and often appears proportionate to the coincident pain.”

With this opinion I do not agree, but hold that the absence of pain, especially if combined with effective rest, favours wasting.

Atrophy, in these diseases, I believe (contrary to the usual teaching) to be an advantage, for the more the muscular tissue becomes atrophied the less will there be of spasm and consequent irritation of the joint, and the less power the patient will have to put his joint to an excessive strain at the commencement of use, and so he will be prevented from inviting back the irritation.



It has been my lot to meet with several cases of hip joint disease, in which this symptom of wasting as well as that of lameness was wanting, and had I not applied my new method of diagnosis, I should not have detected the existence of any disease in the hip. The patients had only complained of obscure pains at night in the limb. In one case where I had been consulted, I informed the parents of the patient that hip joint disease existed. They doubted me, and two other surgeons were called in consultation, but through not having had sufficiently early notice I was not present. The parents judged themselves slighted, and I was set aside. My successors did not judge it a case of serious import, yet it ended fatally.

The absence of wasting is no good omen to the sufferer. Rapid and early atrophy of the muscles often coincides with early relief of the local irritation. I know of no degree of muscular

atrophy the result of joint disease, which is not reeoverable, once the joint is well. Rapid wasting of the limb is Nature's kind but rude way of attempting a cure, illustrating the old adage that, though Nature may be a fair physician, she is but a sorry surgeon.

I shall next notice briefly the signs of recovery.

The soft parts around the joint should appear and feel well, atrophied, and there should be an entire absence of pain and tenderness in the part, as elicited by the following tests :—As to pain, the patient should awake from sleep in perfect ease, even though he may have been reeling on the affected limb. As to tenderness, he should, when pressure is applied to the ligaments between their attachments, have no pain at that point, nor when pereussion is performed on the limb unawares.

The patient should always in chronic cases

maintain the restraint for a period after the joint is sound. The surgeon need have no anxiety of any evil result should he, through over caution, prolong the rest unnecessarily.

I admit that a vast number of acute cases, arising from rheumatism, gout, and other constitutional disturbances, recover with but little or none of what I would term rest; but fixed rest is a necessity for the joints that may have entered upon the chronic stage.

In conformity with the proverb that no rule is without an exception, cases do occur where ankylosis will take place whatever treatment is adopted, yet these cases I am satisfied will under this method become of extremely rare occurrence.

These exceptional cases will certainly be met with, and use having failed to restore the functions of the joint, then the operation of forced flexion and extension should be resorted to (not passive motion.)

Should this not be successful within a short period, it is a sure indication that either the joint is not sound or a case for permanent ankylosis.

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## ABSTRACT.

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THE following conclusions suggest themselves, as a result of my practice, during ten years, of the method here explained.

1.—The main obstacle to the cure of an inflamed joint is the friction of its surfaces; consequently the attainment of rest, that is, of immobility, of the articulation, ought to be the principle which should guide the treatment. Pressure and concussion are much less to be feared than friction.

2.—Effectual rest can only be obtained by purely mechanical treatment, and for this purpose the appliances which I here recommend are most effectual.

3.—The use of these appliances is followed by a resolution of all inflammation in nearly

every case, and ensures a perfect 'cure' in most instances.

4.—Amputation and excision in joint diseases are, consequently, superseded—the exceptions being extremely rare.

5.—To ensure permanency of cure the control should be maintained for a period beyond the time when resolution has taken place. This prolonged arrest of a joint's movements, for even an unnecessarily long period, certainly never does harm.

6.—The more an inflamed joint is moved the stiffer does it become ; while the more effectually it is fixed, the sooner, and the more completely, is its capability of movement restored. Occasionally, in the use of the method here advocated, temporary stiffness occurs, which gradually wears off without interference, but true ankylosis is extremely rare.

7.—Pain may be so great that no anodyne drug in less than a toxic dose would alleviate

it, yet mechanical control, intelligently applied, will infallibly give ease. Emaciation (generally in these cases the direct result of continued pain) is prevented at an early stage, and arrested when present in a later stage.

8.—Aspiration of joint effusion should be practised in chronic cases as soon as fluctuation is detected, and frequently repeated if fluctuation recur. This operation is attended with no risk. When suppuration exists with external communication (sinuses) it is of importance that the sinuses should be treated by simple ablution, and with no bandage around the suppurating joint. Destruction of the articular cartilage does not necessarily involve ankylosis and recovery with defective movements.

9.—A gradual increase of pain, without extraneous cause, and its sudden cessation, frequently indicate rupture of the joint, though there may be no appreciable increase of heat or effusion.

10.—With the means placed at the disposal



of the surgeon, by this method, counter-irritants and all local applications are of no value, and consequently are objectionable. Under this head is of course included that venerable relic, but "strange device," "Scott's dressing;" the undoubted occasional advantages of which are clearly in exact proportion to its rigidity.

11.—Mechanical treatment, well adapted, always benefits every case of joint disease, and with the correct practice of this method in hip disease, eversion and inversion will not occur.

12.—Absorption of the head of the femur may occur without suppuration in the practice of this method, but is a rare occurrence; and should shortening take place from absorption, it may be practically diminished if the use of a shallow patten under the sound limb be persisted in.

13.—If the patient be able to touch the ground with the toe of the affected limb, the depth of the patten has to be increased in hip joint disease; and in knee affections both the patten and splint have to be increased in height.

14.—If the hip appliance be not so fitted as to remain continuously behind the trunk, it will not give any ease from pain, or benefit the joint in any way; so, to avoid pain, and eversion or inversion of the thigh, the upright portions of the hip appliance must be fitted to remain uninterruptedly over the prominence of the buttock, and not to rotate towards the diseased side; moreover it is necessary not to interrupt for a moment the first stage of the treatment in hip disease.

15.—To enable the patient to use the knee appliance without irksomeness, the patten and splint should be so arranged that the patient's shoulders may be level.

16.—The cause of such frequent failure to cure inflamed joints is here attributed to their imperfect immobilisation in cases even where the value of actual rest is acknowledged, and also to a blind reliance upon local medications which have been accredited with virtues really belonging to the mechanical means associated with them.



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